Texas Department of Transportation

Technical Advisory

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Fly Ash Advisory Notice

In order to comply with various air quality measures intended to reduce low-level ozone and smog, various power plants across the state have begun retrofitting low-NOx burners into the power plant operations.

A side effect of this equipment change can sometimes be an increase in the residual carbon found in the fly ash we use in hydraulic concrete. Although carbon itself is not detrimental to concrete, it does adsorb air-entraining admixtures (AEA), which results in a lower total air content of the fresh and hardened concrete.

Adequate entrained air in concrete has long been known to add freeze-thaw protection and improved durability in hardened concrete, and it also contributes to improved workability of the fresh concrete. An excess of entrained and entrapped air, however, results in strength loss and possible decreased durability due to higher permeability of the concrete.

Dosing additional AEA to compensate for the amount lost to adsorption is a common practice that can be effective if the air content of the fresh concrete is closely and frequently monitored. This additional testing and verification is necessary to account for variations in the fly ash carbon properties that, even though may be very small, can cause fluctuations in the resulting air content of the concrete when additional AEA has been added to the mix.

The fly ash suppliers and TxDOT's Cement Laboratory monitor and test all fly ash to ensure the fly ash being supplied to TxDOT projects meets all applicable specifications, including total carbon content as measured by the Loss-on-Ignition (LOI) test. However, these specifications do not fully address the ability of the carbon in the fly ash to render the AEA ineffective.

Various activities within and outside TxDOT are proceeding to find solutions to alleviate this situation. Until such time as adequate laboratory testing or production changes can completely resolve this issue, increased vigilance in monitoring the air content of the fresh concrete should be maintained, particularly with concrete using fly ash from any Texas power plants, but particularly those which have undergone this equipment change over the past two years. Those that we are aware of at this time include: Big Brown, Celanese, Deely, Martin Lake, Monticello, Parish, Pirkey, Sandow, and Spruce.

There have been some suggested measures that might lessen the impact on production rates and quality of the concrete, including changing the type of admixture to a type not so readily adsorbed by the carbon. We are experimenting with this issue, but in the absence of hard data, there is only anecdotal evidence that neutralized vinsol resins may work better with these ashes. Another option is to limit the amount of admixture dosed at the concrete batch plant to 50% over the manufacturer's recommended dosage. If the concrete as it arrives on the jobsite is below specification limits, there are powdered admixtures available in pre-measured bags or liquid admixtures that can be dosed into the back of the truck and mixed at mixing speed until uniformly dispersed. It should be noted that TxDOT personnel should not dictate the addition rates of these admixtures, as that is the responsibility of the material producer.

Other states have experienced these fly ash changes as power plants have transitioned to cleaner burning techniques and still they continue to use fly ash in large quantities and produce good quality concrete. The many benefits of using fly ash in concrete far exceed the temporary problems we are now experiencing. It is also important to note that not all air entrainment problems are caused by the carbon in fly ash. Concrete is a complex chemical system with many different components and multiple factors may be the cause for a problem experienced.

For more information about TxDOT's ongoing activities in this regard, please contact Lisa Lukefahr, P.E., at 512-506-5858 or email her at elukefa@dot.state.tx.us.